PHYS 5720: SUBATOMIC PHYSICS

This is a "field survey" course intended to acquaint the interested advanced undergraduate or beginning graduate student with the foundations, achievements, and current status of the field of elementary particle and nuclear physics.

Tentative syllabus topics (subject to change)

- Brief history of subatomic physics
- Survey of fundamental interactions
- Four-vectors, relativistic transformations
- Symmetries and conservation laws
- Basics of nuclear structure
- Basics of nuclear dynamics
- Lifetimes and cross sections
- QED: Dirac equation
- Feynman rules for QED
- Lepton-lepton scattering
- Compton scattering
- Lepton-quark scattering
- Form factors, quarks and QCD
- Quark distributions in the nucleon
- The quark parton model; Bjorken scaling
- Weak interactions: Fermi theory
- Weak interactions: muon decay
- Weak interactions: pion decay
- Neutrino scattering, Z boson
- CVC, Cabibbo mixing, GIM mechanism
- Weak neutral currents
- Neutrino oscillations
- Beyond the Standard Model: supersymmetry
- Particle physics and cosmology

Course texts

The course textbook(s) are under review. The eventual selection(s) will likely be from among these titles:

B.R. Martin and G. Shaw, *Nuclear and particle physics: an introduction*, 3rd ed., (Wiley, 2019)

D. Griffiths, *Introduction to elementary particles*, 2nd ed., (Wiley-VCH, 2008)

M. Thompson, *Modern particle physics*, (Cambridge Univ. Press, 2013)

B. Povh, K. Rith, C. Scholz, F. Zetsche, W. Rodejohann, *Particles and nuclei*, 7th ed., (Springer 2015)

F. Halzen and A. Martin, *Quarks and leptons*, (Wiley 1984)

D.H. Perkins, *Introduction to High Energy Physics*, 4th ed., (Cambridge Univ. Press, 2000)

Course prerequisites

Prerequisites for the class are: working knowledge of quantum mechanics at the undergraduate level, e.g., completion of the UVa PHYS 3550/3560 course series or equivalent, and working knowledge of special relativity. Prior knowledge of field theory is not required.